CLAIMS

1. An integrally fired, laminated electromechanical transducing element comprising a laminate member formed by integrally firing a plurality of ceramic layers of piezoelectric ceramics or electrostrictive ceramics and internal electrode layers interposed between the ceramic layers,

wherein said internal electrode layers have, as a main component thereof, a base metal having the rigidity not more than 160 GPa.

2. An integrally fired, laminated electromechanical transducing element according to Claim 1, wherein the displacement is 0.06 to 0.15 % when said integrally fired, laminated electromechanical transducing element is driven.

3. An integrally fired, laminated electromechanical transducing element according to Claim 1, wherein the average thickness of said electrode layers is 1 to 8 μm.

4. An integrally fired, laminated electromechanical transducing element according to Claim 1, wherein the electrode forming ratio, i.e. the ratio which the portion formed with the electrodes represents of the total length of the internal electrodes exposed to the cutting section along the direction of lamination of said laminate member is not less than 75 %.

5. An integrally fired, laminated electromechanical transducing element according to Claim 1, wherein the main component of said electrode layers is a selected one of Cu, a Cu alloy and an oxide thereof.

6. An integrally fired, laminated electromechanical transducing element according to Claim 5, wherein said electrode layers further contain at least a selected one of Ca, Mg and Sr.

7. An integrally fired, laminated electromechanical transducing element according to Claim 1, wherein said ceramic layers are formed of PZT which is

an oxide mainly having a perovskite structure of Pb(Zr, Ti)O_3.

8. An integrally fired, laminated electromechanical transducing element according to Claim 7, wherein said PZT contains at least a selected one of Mo and W.

9. An integrally fired, laminated electromechanical transducing element according to Claim 1, which is used for a selected one of an actuator, a piezoelectric transducer and an ultrasonic motor.

10. An integrally fired, laminated electromechanical transducing element according to Claim 1, which is used for a fuel injection actuator of the injector.

11. An integrally fired, laminated electromechanical transducing element comprising a laminate member fabricated by integrally firing a plurality of ceramic layers of piezoelectric ceramics or electrostrictive ceramics and internal electrode layers interposed between said ceramic layers, wherein said internal electrode layers contain, as a main component thereof, a metal of which an oxide is stable in the atmosphere, and wherein the value (A + B) x C is not more than -34,000 $(kJ/mol)^2$, where A is the ionization potential per mol of the metal (kJ/mol), B is the thermal energy of evaporation (kJ/mol) and C is the oxide formation energy of said metal (kJ/mol).

12. An integrally fired, laminated electromechanical transducing element according to Claim 11, wherein the volume resistivity of the metal contained in said internal electrode layers is not more than 15 $\mu\Omega cm$.

13. An integrally fired, laminated electromechanical transducing element according to Claim 11, wherein at least a part of said internal electrode layers is exposed at the side of said laminate member.

14. An integrally fired, laminated

electromechanical transducing element according to Claim 11, wherein the main component of said electrode layers is a selected one of Cu, a Cu alloy and an oxide thereof.

15. An integrally fired, laminated electromechanical transducing element according to Claim 14, wherein said electrode layers contain at least a selected one of Ca, Mg and Sr.

16. An integrally fired, laminated electromechanical transducing element according to Claim 11, wherein said ceramic layers are composed of PZT constituting an oxide having a perovskite structure mainly of $Pb(Zr, Ti)O_3$.

17. An integrally fired, laminated electromechanical transducing element according to Claim 16, wherein said PZT contains at least a selected one of Mo and W.

18. An integrally fired, laminated electromechanical transducing element according to Claim 11, which is used for a selected one of an actuator, a piezoelectric transducer and an ultrasonic motor.

19. An integrally fired, laminated electromechanical transducing element according to Claim 11, which is used for a fuel injection actuator of the injector.

20. An integrally fired, laminated electromechanical transducing element comprising a laminate member fabricated by integrally making a plurality of ceramic layers of a selected one of piezoelectric ceramic and electroristrictive ceramic and internal electrode layers interposed between said ceramic layers,

wherein said internal electrode layers contain, as a main component thereof, a base metal having the volume resistivity of not more than 15 μΩcm and the heat conductivity of not less than 50 W/mK.

21. An integrally fired, laminated electromechanical transducing element according to Claim

20, wherein the volume of said laminate member is not less than 500 mm^3.

22. An integrally fired, laminated electromechanical transducing element according to Claim 20, wherein the sectional area of said laminate member is less than 18 mm^2.

23. An integrally fired, laminated electromechanical transducing element according to Claim 20, which is used as an application with an injection energy of 0.025 to 0.075 mJ/mm^3 for unit volume at the time of driving.

24. An integrally fired, laminated electromechanical transducing element according to Claim 20, wherein the average value of the thickness of said electrode layers is not less than 1 μm.

25. An integrally fired, laminated electromechanical transducing element according to Claim 20, wherein the electrode forming ratio, i.e. the ratio which the portion formed with said electrodes represents of the whole length of said internal electrodes exposed to the cut section along the direction of lamination of said laminate member is not less than 75 %.

26. An integrally fired, laminated electromechanical transducing element according to Claim 20, wherein the main component of said electrode layers is selected one of Cu, a Cu alloy and an oxide thereof.

27. An integrally fired, laminated electromechanical transducing element according to Claim 26, wherein said electrode layers contain at least selected one of Ca, Mg and Sr.

28. An integrally fired, laminated electromechanical transducing element according to Claim 20, wherein said ceramic layers are formed of PZT constituting an oxide mainly having the perovskite structure of $Pb(Zr, Ti)O_3$.

29. An integrally fired, laminated electromechanical transducing element according to Claim

28, wherein said PZT contains at least a selected one of Mo and W.

30. An integrally fired, laminated electromechanical transducing element according to Claim 20, which is used for a selected one of an actuator, a piezoelectric transducer and an ultrasonic motor.

31. An integrally fired, laminated electromechanical transducing element according to Claim 20, which is used for a fuel injection actuator of the injector.

32. An integrally fired, laminated electromechanical transducing element comprising a laminate member fabricated by integrally firing a plurality of ceramic layers of a selected one of piezoelectric ceramic and electrostrictive ceramic and internal electrode layers interposed between said ceramic layers,

wherein the electrode forming ratio, i.e. the ratio which the portion formed with said electrodes represents of the total length of said internal electrodes exposed to the section along the direction of lamination of said laminate member is not less than 75 %, and

wherein the bonding strength between said internal electrodes and said ceramic layers is not less than 40 MPa.

33. An integrally fired, laminated electromechanical transducing element according to Claim 32, wherein the average thickness of said internal electrode layers is not more than 8 μm.

34. An integrally fired, laminated electromechanical transducing element according to Claim 32, wherein the main component of said electrode layers is a selected one of Cu, a Cu alloy and an oxide thereof.

35. An integrally fired, laminated electromechanical transducing element according to Claim 34, wherein said electrode layers contain at least a

selected one of Ca, Mg and Sr.

36. An integrally fired, laminated electromechanical transducing element according to Claim 32, wherein said ceramic layers is composed of PZT constituting mainly an oxide having the perovskite structure of $Pb(Zr, Ti)O_3$.

37. An integrally fired, laminated electromechanical transducing element according to Claim 36, wherein said PZT contains at least a selected one of Mo and W.

38. An integrally fired, laminated electromechanical transducing element according to Claim 32, which is used for a selected one of an actuator, a piezoelectric transducer and an ultrasonic motor.

39. An integrally fired, laminated electromechanical transducing element according to Claim 32, which is used for a fuel injection actuator of the injector.

Substitute Specification